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54 - Automatic Sensitivity CKT for Automatic Anti-Glare Mirror Using Comparison CKT.

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56 - References Patent Publ. S52-1779 (3P,B2)
Pract. Util. PrePubl S50-119142 (JP, U)
U.S. Pat. 3,680,951 (US, A)

57 - Area of practical Utility Application

Automatic Sensing ckt for the automatic anti-glare mirror using comparison ckt characterized by the following. Var. resistor for tuning the switching pt. and rear light sensor are connected in series to form the rear light sensor ckt. The output is taken at the connection between the variable resistor and the light sensor. Fixed resistors and the forward light sensor are connected in series to form the ambient light sensor ckt. The output is taken at the connection between the fixed resistor and the light sensor. The two ckts are connected in parallel to the power supply. The outputs from the rear and ambient light sensing ckt are inputted into the comparison ckt made of op ampts. (i.e., the variable and fixed resistors, and the light sensors form a bridge). The output from the comparison ckt goes into the controlling ckt for the anti-glare mirror operating ckt.

DETAILED EXPLANATION OF THIS PRACTICAL UTILITY

This idea pertains to the controlling ckt for automative automatic anti-glare mirrors, in particular, the sensitivity control ckt that automatically adjusts the switching point according to the ambient luminosity by using comparing ckt which takes the inputs from rear light sensor ckt and foward light sensor ckt that are arranged in parallel.

While driving at night, the head lamp light of the following car reflecting off of the rear view mirror may cause glaring and may be hazardous.

The perception of glare is deeply related to the ambience luminosity. Light from the following car does not always cause glare. For e.g., the light of the following car does not cause glare while driving in the well lit area.

Fig. 1 shows the threshold of glare perception (i.e., the strength of the oncoming light) as a function of the ambient light. The figure indicates that the threshold of glare increases as the ambient luminosity is raised. Conversely, the threshold decreases as the ambient luminosity is decreased. The result of testing under actual driving conditions indicates that the perception threshold curves differ for each individual. The slope of the curve, however, is about the same for most people.

The petitioner(s) have invented, based on the facts described above, automatic anti-glare mirror with automatic switching sensitivity control ckt shown in Fig. 2., as posted in Pat. Application S53-85236(?) (This is referred to as "Conventional" hereafter).

The "conventional" ckt contains ambient light sensor (2) as well as the rear light sensor (1). A transistor 3 is placed between the sensors (1) and (2),

allowing the mirror switching (operating) ckt to switch according to the glare perception curve in Fig. 1. (5) and (6) are fixed resistors and (7) is a variable resitor.

The above "conventional" ckt, however, uses three transistors and is susceiptible to ambient temperature change. That is, the transistor characteristic changes as the temperature changes, thus causing the rear sensor potential (or the Emittor Voltage of the transistor) to drift and the switching characteristic drifts away from the glare threshold in Fig. 1. It was necessary to implement a measure to compensate for the change of characteristics due to temperature.

Furthermore, the deviations in DC current gain, E-B voltage characteristics, etc., among the transistor units made the initial tuning quite difficult. The deviations in those characteristics caused deviations in the rear light sensor voltage (or the emitter voltage). In order to have the ckt respond according to the threshold curve of Fig. 1, the range of the resistance of the fixed resistor (5) and (6) had to be kept large.

Thus, the tuning became costly in time and the fine tuning became excessively difficult. This is another area, where the improvement was necessary in the "conventional" ckt.

This invention shall improve the above points in the automatic sensitivity control ckt for automatic anti-glare mirror.

In the following, the invention is explained in detail with concrete examples.

The Fig. 3 shows an exampl of the practical application. In the drawing, 11 is the rear light sensor ckt 12 is the ambient (forward) light sensor ckt.

The ckts 11 and 12 are connected in parallel to the power supply 13, 13'. The rear light sensor ckt 11 is made of variable resistor R1, fixed resistor R2, and light sensor S1 connected in series from the anode ( ) of the power supply 13. The ambient light sensor ckt 12 is made of fixed resistor R3, and light sensor S2 connected in series.

The light sensors S1 and S2 are made of optical semiconductors such as Cd,S.

The output for the rear sensor ckt 11 is taken at the connection between the fixed resistor and the light sensor (pt. 14 in the dwg), and is connected to the inverted input 16 of the differential op amp. The output of the ambient sensor ckt 12 is taken at pt. 15 in the dwg., and is connected to the non-inverted input 17 of the differential op amp. ("Differential op amp" and "comparison ckt" used interchangeably).

The "comparison ckt" in the above, for example, may be made of a differential op amp. The output V, from this ckt is connected to control ckt V_2, switching ckt V_3, and eventually to the mirror operating ckt V_4. I.e., the comparison ckt V_1 is operated while using the signal at non-inverted input 17 as a "reference point", and the output from V_1 triggers the action of the control ckt V_2 and switching ckt V_3.

For the optical sensors used in ckt 11 and 12, photo-transistors may be used, as indicated in Fig. 4 (Pt_1, PT_2). It is also possible to use photo-diodes, as shown in

Fig. 5 (PD_1, PD_2). In Figs. 4 and 5, R_4, R5 indicates the resistance at the output (Output impedance?)

The actual ckt in this patent is constructed as described above. When used, the fixed resistors R_2 and R_3 will be tuned so that the ckt. operates according to the glare perception threshold curve (Fig. 1). First, "dark" and "bright" environments must be chosen.[1] In the dark environment, shine the rear sensor with the light intensity given by the glare perception curve. control R_2 so that the comparison ckt V_1 is activated (i.e., produces output of 1). Fix the value of R_2 to this. In the bright environment, shine the rear sensor with the light intensity given by the curve and control R_3 so that the comparison ckt produces output =1.

Fig. 1

The rear sensor ckt and forward sensor ckt are constructed independently from each other (with respect to the power supply) and since the op-amp with high input impedance is used for the comparison ckt V_1, the effects of changing the resistor of one of the sensor ckt has virtually no effect on the other ckt. Thus, the timing of the ckt to

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[1]Two points on the horizontal axis of Fig. 1.

the glare perception threshold curve is done easily and accurately.

Tune the ckt as described above. While driving a car at night, if the head lamp of the following car hits the mirror, the ambient light and the light from the rear will be compared and when the criteria from the Fig. 1 is met, the comparator ckt V_1 produces the output signal of "1" via the control ckt V_2, the switching ckt V_3 and the operating ckt V_1, the mirror will be changed to "antiglare state" (i.e. dark?).

The switching sensitivity is raised when the ambient is dark, and lowered when the ambient is bright. Variable resistor R_1 is used to compensate the differences among individuals. The ckt structure is such that the comparator ckt produces output signals based on the input from the rear sensor ckt 11 and the ambient sensor ckt 12, and the control ckt V_2, etc. kicks in upon receiving the signal "1 from the comparator ckt. This ckt structurer allows very optimum switching of the control ckt.

Since the comparator ckt V_1 and the control ckt V_2 is operated based on the comparison between the rear (11) and ambient (12) sensor ckts, the temperature dependence of the component characteristics of the sensors S_1 and S2 will cancel each other, thus the switching brightness (of the rear light) will not drift as the temperature changes.

The Fig. 6 shows yet another example of application of this invention. In this example, a differential op-amp is used as the comparison ckt V_1'. A position feed-back ckt made of resistors R_6 and R7 are attached to this. The output signal from the ambient sensor

ckt 12 goes through non-inverting amplifier V_5 into the non-inverting input 17 of the comparator ckt.

The ckt constructed above has hystesis characteristics for the voltage at the non-inverting input 17 of V_1' (i.e., the reference voltage of the comparator ckt V_1'). This prevents the chattering, reduces the frequency of the mirror switching and provides safer driving conditions.

In the following, the process of generating hystesis is explained using Figs. 8 through 10.

Let V_1 denote the input voltage at the inverted input 16 of the comparison ckt, and V_2 the input voltage at the non-inverted input 17. Furthermore, V_o denotes the output voltage from the uninverted amplifier V_5.

Suppose the luminoscity on the ambient light sensor S_2 is constant and the output voltage from the uninverted amplifier (V_o out of V_5) is also constant.

Consider the case where the luminosity on the rear sensor S_1 is gradually increased. As shown in Figs. 8 and Fig. 19 where indicated by number 18, the output from the rear light sensor ckt, i.e., the input voltage V_1 into the inverted input 15 of the comparison ckt V_1', will decline. The input voltage V_1 for when the mirror is switched to anti-glare (dark) state is given by the following equation.

V_{02} above denotes the output voltage from the comparison ckt V_1' at the "zero" level.

On the other hand, consider the case when the mirror is switched from the anti-glare to normal state, as

indicated by path 19 on the Fig. 9. The input voltage V_1 at the inverted input 16 when the mirror switches is given by the following equation:

V_{01} above denotes the output voltage from the comparison ckt. V' at "one" level.

Comparing the above equations (1) and (2), it is clear that $V_1 < V_1'$ since $V_{02} < V_{01}$. Thus, the hystesis in the reference voltage V_2 of the comparison ckt induces hysteisis in the input voltage V_1 at the non-inverted input 16. Thus, the hystesis in the strength of light (luminosity) in the input light into the rear light sensor S_1, which causes the frequency of the switching to decline.

By adding non-inverting amplifier V_5, the voltage denoted by V_0 in the above equation can be multiplied by optimum amount. This allows the control of the width of the hysteisis to optimum amount.

Next, Fig. 7 shows another example of application. In this ckt, the non-inverting amplifier in Fig. 6 is replaced by a transistor R in emitter-follower configuration. An additional diode D is added to compensate for the change in emitter-base voltage due to the temperature change. The mechanism of operation is almost identical to that of the ckt in Fig. 6.

(In Figs. 6 and 7, the components of the ckt that are the same or equivalent to the component in Fig. 3 is indicated using the same marks and numbers).

For the light sensor in Figs. 6 and 7, a photo-transistor or photo diode may be used in place of the photo resistor sensor, as shown in Figs. 4 and 5.

The following is the summary of the advantage of using the ckt described in this document.

The mirror is operated based on the output from comparator (differential ckt), which takes the input from rear light sensor and ambient light sensor, which are connected in parallel. The effect of the temperature on the sensor component characteristics is thus cancelled, and the switching point does not drift from the originally set level.

The output from the comparator ckt is digital, i.e., "0" or "1", thus the switching of the mirror is done accurately. Furthermore, the usage of the comparator ckt allows the use of digital controlling ckt. This facilitates the construction of such controlling ckt and further increases the accuracy of the switching.

The tuning of the device is greatly facilitated by the fact that rear and ambient sensor ckts can be tuned independently and separately. since the input impedance of the comparator ckt is very high, the sensor ckts can be tuned without affecting the other sensor ckt.

An op-amp can be used for the comparison ckt, and when a position feed-back is added to the comparison ckt, it induces hysteisis in the reference voltage of the comparison ckt. Thus, chattering is prevented and the frequency of switching is reduced.

Brief Description of the Figures

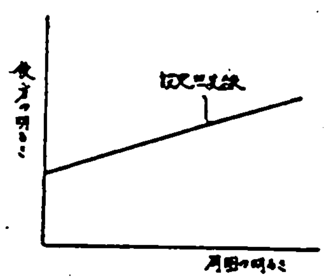
Fig. 1: Glare perception threshold, as a function of ambient brightness.

Fig. 2: An example of "conventional" ckt.

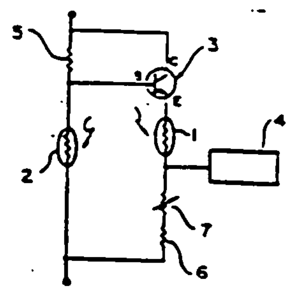
Fig. 3: An example using the automatically

	compensating ckt, proposed in this document.
Fig. 4:	An example, using photo transistor as the light sensor, instead of photo-resistor in Fig. 3.
Fig. 5:	An example, replacing the photo resistor in Fig. 3 with photo-transistor.
Figs. 6,7:	Example of actual implementation of the ckt shown in Fig. 3.
Figs. 8,9,10:	Spec. Curve, to explain the operation of the ckt in Figs. 6, 7.
Fig. 11:	Rear light sensor ckt.
Fig. 12:	Ambient light sensor ckt.
Fig. 13, 13':	Power supply terminal.
Fig. 14:	Output from the rear light sensor ckt.
Fig. 15:	Output from the ambient sensor ckt.
Fig. 16:	Inverted input.
Fig. 17:	Uninverted input.
D:	Diode for temperature compensation.
PD_1, PD_2:	Photo diodes.
PT_1, PT_2:	Photo transistors
Q:	transistor
R_1:	Variable resistor
R_2 thru R7:	Resistors (fixed)
S_1, S_2:	Photo resistor (such as Cd S)
V_1, V_2':	Comparison ckt.
U_2:	Control ckt.
U_3:	Switching ckt.
U_4:	Operating ckt.

第1図



第2図　従来



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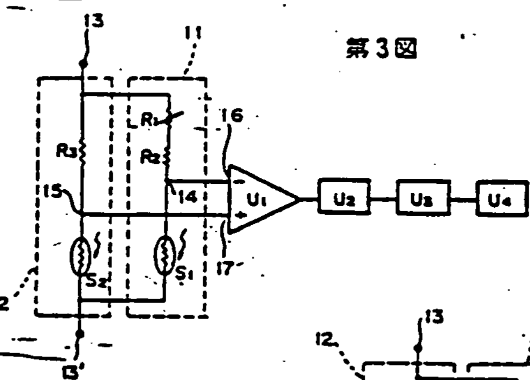
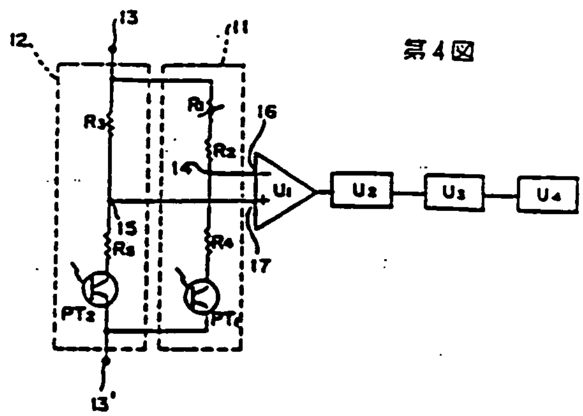


第4図



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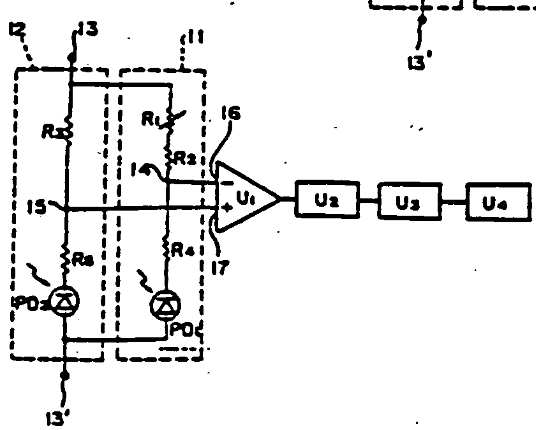
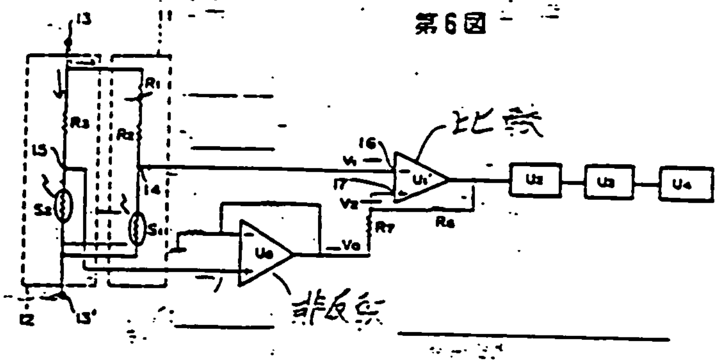
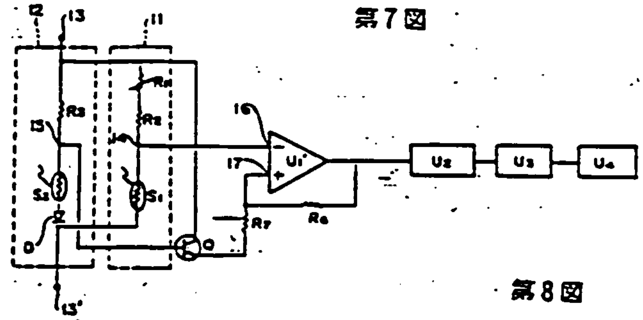


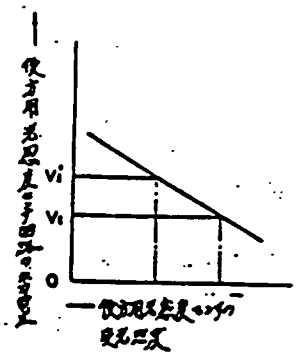
第6図



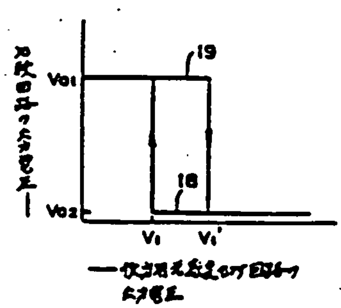
第7図



第8図



第9図



第10図